

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER
<b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>		<b>027650-924</b> <small>U.S. APPLICATION NO. (if known, see 37 C.F.R. 1.5)</small> <b>09/787201</b> <small>Unassigned</small>
INTERNATIONAL APPLICATION NO. <b>751099/01593</b>	INTERNATIONAL FILING DATE <b>13 September 1999 (13.09.99)</b>	PRIORITY DATE CLAIMED <b>15 September 1998 (15.09.98)</b>
TITLE OF INVENTION <b>A METHOD OF HOMOGENIZATION</b>		
APPLICANT(S) FOR DO/EO/US <b>INNINGS, Fredrik; MALMBERG, Rolf</b>		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371. 3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and the PCT Articles 22 and 39(1). 4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date. 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US) 6. <input type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)). 7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). b. <input type="checkbox"/> have been transmitted by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input checked="" type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). 9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). 10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). Items 11. to 16. below concern other document(s) or information included: 11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. 12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. 13. <input type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. 14. <input type="checkbox"/> A substitute specification. 15. <input type="checkbox"/> A change of power of attorney and/or address letter. 16. <input checked="" type="checkbox"/> Other items or information:		
Unexecuted Declaration; Bibliographic Data Sheet; Two (2) sheets of formal drawings; Publ. Appln. No. WO 00/15327; PCT Forms ISA/210 and IPEA/401.		

U.S. APPLICATION NO. (if known) **09/7787201**

Unassigned

INTERNATIONAL APPLICATION NO.  
PCT/SE99/01593ATTORNEY'S DOCKET NUMBER  
027650-92417. ☒ The following fees are submitted:

CALCULATIONS

PTO USE ONLY

**Basic National Fee (37 CFR 1.492(a)(1)-(5)):**

Neither international preliminary examination fee (37 CFR 1.482)  
nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO  
and International Search Report not prepared by the EPO or JPO ..... \$1,000.00 (960)

International preliminary examination fee (37 CFR 1.482) not paid to  
USPTO but International Search Report prepared by the EPO or JPO ..... \$860.00 (970)

International preliminary examination fee (37 CFR 1.482) not paid to USPTO  
but international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$710.00 (958)

International preliminary examination fee paid to USPTO (37 CFR 1.482)  
but all claims did not satisfy provisions of PCT Article 33(1)-(4) ..... \$690.00 (956)

International preliminary examination fee paid to USPTO (37 CFR 1.482)  
and all claims satisfied provisions of PCT Article 33(1)-(4) ..... \$100.00 (962)

**ENTER APPROPRIATE BASIC FEE AMOUNT = \$ 1,000.00**

Surcharge of **\$130.00 (154)** for furnishing the oath or declaration later than  
months from the earliest claimed priority date (37 CFR 1.492(e)).

20 ☐ 30 ☐

\$

Claims	Number Filed	Number Extra	Rate		
Total Claims	4 -20 =		X\$18.00 (966)	\$	
Independent Claims	1 -3 =		X\$80.00 (964)	\$	
Multiple dependent claim(s) (if applicable)			+ \$270.00 (968)	\$	

**TOTAL OF ABOVE CALCULATIONS = \$ 1,000.00**

Reduction for 1/2 for filing by small entity, if applicable (see below).

**SUBTOTAL = \$ 1,000.00**

Processing fee of **\$130.00 (156)** for furnishing the English translation later than  
months from the earliest claimed priority date (37 CFR 1.492(f)).

20 ☐ 30 ☐

\$

+

**TOTAL NATIONAL FEE = \$ 1,000.00**

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by  
an appropriate cover sheet (37 CFR 3.28, 3.31). **\$40.00 (581)** per property +

\$

**TOTAL FEES ENCLOSED = \$ 1,000.00**Amount to be:  
refunded \$

charged \$

- a. ☐ Small entity status is hereby claimed.
- b. ☒ A check in the amount of \$ 1,000.00 to cover the above fees is enclosed.
- c. ☐ Please charge my Deposit Account No. 02-4800 in the amount of \$ \_\_\_\_\_ to cover the above fees. A duplicate copy of this sheet is enclosed.
- d. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-4800. A duplicate copy of this sheet is enclosed.

**NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.**

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09/787201

WO 00/15327

PCT/SE99/01593

A METHOD OF HOMOGENIZATION

## TECHNICAL FIELD

- 5 The present invention relates to a method of homogenization of a pressurised liqueform emulsion, in which the liquid is caused to pass at least two concentrically placed homogenization gaps.

## BACKGROUND ART

- 10 Homogenization is an industrial process which has long been employed and whose purpose is, in a fat emulsion such as, for example, milk, to shear or split the largest fat globules into smaller fat globules and by such means stabilise the fat emulsion. For, for example, milk, this implies that cream-clotting is prevented, and the vast majority of all consumer milk today is homogenized.

- 15 Homogenization normally takes place by mechanical processing, such that the fat emulsion, which is at a high infeed pressure, is forced at high speed to pass through a very narrow gap where the fat globules of the fat emulsion are broken up as a result of the turbulence which occurs at high speeds and by means of cavitation bubbles which implode in the liquid. The  
20 process takes place during a very short period of time and what happens during this brief period is that the speed of the fat emulsion on its passage increases while the pressure drops, which results in the liquid coming to the boil.

- 25 A homogenizer substantially consists of a large piston pump which gives high pressure, and a counter-pressure device where the homogenization proper takes place. The counter-pressure device, the homogenizer valve in turn consists of a pressurised, resilient valve cone, a valve seat and a valve housing which surrounds the valve cone and the valve seat. The valve cone and the valve seat are normally rotation-  
30 symmetric and are disposed such that between these parts, a radial throttle occurs which constitutes a homogenization gap. The height, width and length of the gap determine the volume at which the homogenization takes place. This volume must be as slight as possible in order to obtain an efficient homogenization. The gap height is reduced at an elevated pressure  
35 on the liquid which is to be homogenized, at the same time as a greater flow entails that the gap height is increased.

It is often desirable today to employ a lower pressure on the liquid, at the same time as the intention is to increase the flow volume. This implies that a longer homogenization gap is needed. Various methods for lengthening the homogenization gap are known from the patent literature.

5 Swedish Patent Application SE 9701504-4 discloses a homogenization valve in which a number of homogenization gaps are concentrically disposed, which thereby gives an increased length of the homogenization gap.

Most generally, it is insufficient merely to extend the homogenization gap. In order to obtain as efficient homogenization as possible, where all fat globules, for example in milk, are sheared or split into such small fat globules that a stable emulsion is obtained. This problem has most generally been solved by carrying out the homogenization process in several stages.

10

USPS 5,482,369 discloses a further method of obtaining an efficient homogenization. This method takes as its point of departure that the component parts or phases of the emulsion, for example water and fat which are both under pressure, are caused to pass through two opposed nozzles so that the two jets meet at high speed. The two nozzles are fixed and have a very narrow gap where the two liquids are to pass. Milk, which already from the outset consists of a mixed, unstable fat emulsion which may contain

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20 naturally occurring particles would, in such a homogenizer, rapidly block the narrow gaps of the nozzles and render the process unusable.

## OBJECT OF THE INVENTION

One object of the present invention is to realise a homogenization gap which is of optimum design and is controllable for desired flow and pressure, at the same time as a more efficient and improved homogenization is obtained by utilising the speed at which the liquid passes the homogenization gap.

25

## 30 SOLUTION

This and other objects have been attained according to the present invention in that the method of homogenization of the type described by way of introduction has been given the characterizing feature that the liquid, when passing out from one of the homogenization gaps at high speed and in

35 a restricted space, meets the liquid out from one or more of the other homogenization gaps.

Preferred embodiments of the present invention have further been given the characterizing features as set forth in the appended subclaims.

#### BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

- 5 One preferred embodiment of the present invention will now be described in greater detail hereinbelow, with particular reference to the accompanying Drawings, in which:

Fig. 1 shows, partly in section, a conventional homogenization valve; and

- 10 Fig. 2 shows, partly in section, a part of a homogenization valve in which the method according to the present invention may be reduced into practice.

- The Drawings show only those details and parts essential to an understanding of the present invention, and the placing of the  
15 homogenization valve in the complete homogenizer, which is well-known to a person skilled in the art, has been omitted.

#### DESCRIPTION OF PREFERRED EMBODIMENT

- A homogenization valve 20 of conventional type is shown in Fig. 1,  
20 the homogenization valve 20 substantially consists of a valve housing 21 with an inlet 22 and an outlet 23 for the liquid which is to be homogenized, as well as a movable valve cone 1 and a fixed valve seat 2.

- A part of a homogenization valve 20 of the type in which the method according to the present invention may be reduced into practice is shown in  
25 Fig. 2. In the preferred embodiment, the valve seat 2 is rotation-symmetric and has a central throughflow channel 4 for the liquid which is to be homogenized. The through channel 4 constitutes an extension of the inlet 22 of the homogenization valve 20. From a central plane, the valve seat 2 is designed so that it is identical on both sides of the central plane and is, thus,  
30 reversible in the valve housing 21, which implies a doubled service life for the valve seat 2.

- In addition to the central throughflow channel 4, the valve seat 2 has a throughflow channel 5 for the liquid which is to be homogenized. Along its  
35 extent, the throughflow channel 5 has a number of narrow connection bridges 6 which hold together the two concentric parts of the valve seat 2.

The valve cone 1, which is also rotation-symmetric, is pressurised, normally by a hydraulic or pneumatic piston 24, but may, in simpler versions, be pressurised by means of a grub screw which acts via a spring. The valve cone 1 is also movable, for example, via the oil in the cylinder, in order to absorb the rapid flow variations which occur in the liquid which is to be homogenized. This elasticity is necessary in order to handle the flow variations that naturally occur in piston pumps.

The valve cone 1 in the preferred embodiment is designed such that the lower region facing towards the valve seat 2 consists of a separate part 7, this part 7 being secured on a central part 8 of the valve cone 1. From a central plane, the part 7 is designed so that it is identical on both sides of the central plane and is, thus, reversible, which implies a doubled service life for the part 7 of the valve cone 1.

In the lower part 7 of the valve cone 1, there is provided a throughflow channel 3. Along its extent, the throughflow channel 3 has a number of narrow connection bridges 9 which hold together the two concentric parts of the part 7 of the valve cone 1.

On the valve seat 2, there are at least two narrow, planar surfaces 10 and 11 which each constitute one side of a homogenization gap 12, 13. Additional homogenization gaps 12, 13 may also occur pairwise and concentrically placed, but a homogenization valve 20 with more than four homogenization gaps 12, 13 would probably be difficult to manufacture.

On the valve cone 1, there are likewise two narrow, planar surfaces 14, 15 which each constitute the other side of the homogenization gaps 12 and 13. The surfaces 10, 11, 14, 15, respectively are placed in register and in spaced apart relationship to one another, this being designated gap height and is normally 50-200 $\mu$ m. The gap height may be varied with varied pressure and flow, in that the valve cone 1 is moved closer to or further away from the valve seat 2.

The distance between the two homogenization gaps 12 and 13 is the same as the width of the throughflow channel 3. The throughflow channel 3 may have a slight extension 16 provided in the valve seat 2. Alternatively, the valve cone 1 has a completely straight side which consists of the surfaces 10 and 11 and their extension. The surfaces 10, 14 and 11, 15, of the homogenization gaps 12 and 13, respectively should be completely straight

in order the better to guide the liquid through the homogenization gaps 12 and 13.

5 The liquid, normally milk, which is to be homogenized is led into the homogenizer and is there pressurised at approximately 10-25 Mpa. The milk normally has a fat content of 0.5-3.5 per cent and is at a temperature of 55-80°C.

10 The liquid is led in through the inlet of the homogenization valve 20 and when it reaches the valve seat 2 the liquid is distributed so that it partly passes through the central throughflow channel 4 and partly through the channel 5. Thereafter, the liquid passes through each respective homogenization gap 12 and 13 and a first homogenization takes place. In the passage, a very rapid pressure drop down to 0 Mpa is obtained, at the same time as the speed of liquid increases, which results in the liquid beginning to boil.

15 When the liquid from the two homogenization gaps 12 and 13 departs from the gaps 12 and 13, they will meet at high speed. This contributes to a large extent in improving the homogenization. Once the two flows have converged together, the speed reduces and the pressure once again increases. The liquid stops boiling and the steam bubbles in the liquid implode. The entire process takes place during a few fractions of a second, 20 and in the violent process where the high speed and converging of the two flows into one another give rise to turbulence and cavitation, the fat globules which are to be found in the liquid are sheared or split into smaller particles or globules.

25 The process takes place in a restricted space, i.e. between the outlets from the two homogenization gaps 12, 13 and partly in the throughflow channel 3, as well as possibly in its extension 16. Thereafter, the ready-homogenized liquid passes out through the throughflow channel 3 and departs from the homogenization valve 20 through its outlet 23.

30 Given that the gap height for the homogenization gaps 12, 13 may be varied, it is possible, on washing of the homogenization valve 20, to increase the distance between the valve cone 1 and the valve seat 2 and thereby obtain easily washed surfaces. Given that the valve seat 2 and the part 7 of the valve cone 1 have hygienic sealings against the valve housing 21 and the 35 part 8 of the valve cone 1, a hygienic homogenization valve 20 will be

obtained which satisfies the requirements of the food industry and which may be washed using conventional equipment.

- 5 As will have been apparent from the foregoing description, a method of homogenization is realised which combines conventional homogenization with counter-directed flows, which considerably improves the homogenization process. In that it is the homogenization gaps that create the counter-directed flows, problems which fixed nozzles entail are obviated in respect of the homogenization of milk.

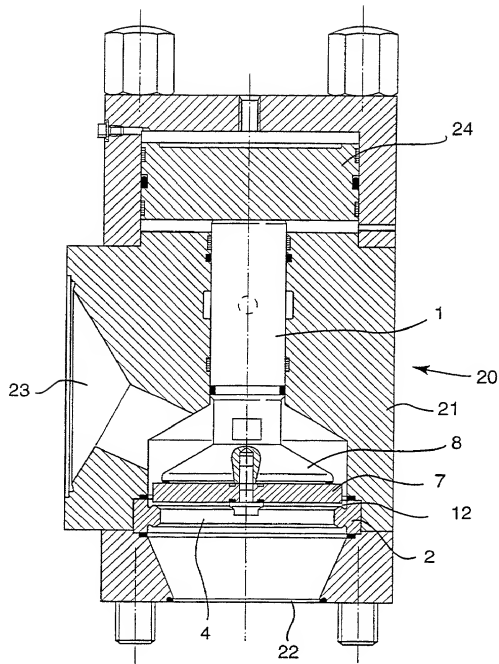
- 10 The present invention should not be considered as restricted to that described above and shown on the Drawings, many modifications being conceivable without departing from the scope of the appended Claims.



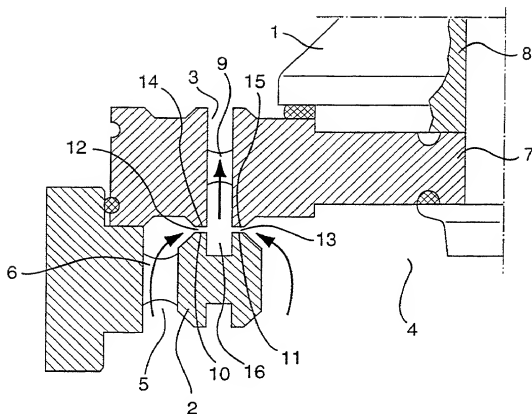
**WHAT IS CLAIMED IS:**

1. A method of homogenization of a pressurised liqueform emulsion, in which the liquid is caused to pass at least two concentrically placed homogenization gaps (12, 13), characterized in that the liquid, when passing out from one of the homogenization gaps (12) at high speed and in a restricted space, meets the liquid out from one or more of the other homogenization gaps (13).
2. The method as claimed in Claim 1, characterized in that the homogenization gaps (12, 13) are created in the space between two narrow surfaces (10, 11) on a valve seat (2), and two narrow surfaces (14, 15) on a valve cone (1).
3. The method as claimed in Claim 2, characterized in that the liquid is led into the homogenization gaps (12, 13) through a central throughflow channel (4) and a concentric throughflow channel (5) which are provided in the valve seat (2).
4. The method as claimed in Claim 2, characterized in that the liquid departs from the homogenization gaps (12, 13) via a throughflow channel (3) provided in the valve cone (1).

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*Fig 1*

2/2

*Fig 2*



**COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (CONT'D)**  
(Includes Reference to Provisional and PCT International Applications)

Attorney's Docket No.

027650-924

I hereby claim the benefit under Title 35, United States Code, §120 of any United States applications(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose to the Office all information known to me to be material to the patentability as defined in Title 37, Code of Federal Regulations §1.56, which became available between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. §120:

U.S. APPLICATIONS		STATUS (check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

**PCT APPLICATIONS DESIGNATING THE U.S.**

PCT APPLICATION NO.	PCT FILING DATE	U.S. APPLICATION NUMBERS ASSIGNED (if any)	
PCT/SE99/01593	13.09.99	Unassigned	x

I hereby appoint the following attorneys and agent(s) to prosecute said application and to transact all business in the Patent and Trademark Office connected therewith and to file, prosecute and to transact all business in connection with international applications directed to said invention:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

**COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (CONT'D)**  
(Includes Reference to Provisional and PCT International Applications)

Attorney's Docket No.

027650-924

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POST OFFICE ADDRESS			
FULL NAME OF SIXTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
RESIDENCE		CITIZENSHIP	
POST OFFICE ADDRESS			
FULL NAME OF SEVENTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
RESIDENCE		CITIZENSHIP	
POST OFFICE ADDRESS			
FULL NAME OF EIGHTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
RESIDENCE		CITIZENSHIP	
POST OFFICE ADDRESS			